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PATENT APPLICATION
TRANSMITTAL**

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Attorney Docket No.

000004.000661

First Inventor or Application Identifier

Morikatsu MATSUDA *et al.*

Title

PUNCHING MACHINE AND METHOD THEREOFPTO
Jc903 U.S.
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APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO:

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1. ☒ Fee Transmittal Form (e.g. PTO/SB/17)
(Submit an original and a duplicate for fee processing)
2. ☒ Specification Total Pages **18**
3. ☒ Drawing(s) (35 U.S.C. 113) Total Sheets **7**
4. ☒ Oath or Declaration Total Pages **2**
- a. ☐ Newly executed (original or copy)
- b. ☒ Copy from a prior application (37 C.F.R. §1.63(d))
(for continuation/divisional with box 15 completed)
- i. ☐ **DELETION OF INVENTOR(S)**
Signed statement attached deleting inventor(s) named
in the prior application, see 37 C.F.R. §1.63(d)(2) and
1.33(b).
5. ☒ Incorporation By Reference (usable if box 4B is checked)
The entire disclosure of the prior application, from which a copy of the
oath or declaration is supplied under Box 4B, is considered to be part
of the disclosure of the accompanying application and is hereby
incorporated by reference therein.

ACCOMPANYING APPLICATION PARTS

6. ☐ Assignment Papers (cover sheet & document(s))
7. ☐ 37 C.F.R. §3.73(b) Statement ☐ Power of Attorney
(when there is an assignee)
8. ☐ English Translation Document (if applicable)
9. ☒ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations
10. ☒ Preliminary Amendment
11. ☒ White Advance Serial No. Postcard
12. ☐ Small Entity Statement(s) ☐ Statement filed in prior application. Status still proper and desired.
13. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
14. ☒ Other: Request For Approval of Drawing Changes

15. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below:

☒ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application no.: 08/836,029

Prior application information: Examiner: C. Goodman

Group Art Unit: 3724

16. Amend the specification by inserting before the first line the sentence:

☒ This application is a ☒ Continuation ☐ Division ☐ Continuation-in-part (CIP)
of application Serial No. 08/836,029 Filed on April 27, 1997☐ This application claims priority of provisional application Serial No.

Filed

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Docket No. 000004.00661

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTOR(S) Morikatsu MATSUDA *et al.*

APPLN. NO: New Application

FILING DATE: Herewith

FOR: **PUNCHING MACHINE AND METHOD THEREOF**

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Respectfully Submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Continuation Application of)	
Appln. No. 08/836,029; filed)	
August 27, 1997 in the name of:)	Group Art Unit: 3724
)	
Morikatsu MATSUDA et al.)	Examiner: C. Goodman
)	
Application No.: Unassigned)	Attorney Docket No. 000004.00609
)	
Filed: Concurrently Herewith)	
)	
For: PUNCHING MACHINE AND)	Date: September 13, 2000
METHOD THEREOF)	

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 2, lines 7-8, delete "according to claim 1 of the invention,";

lines 28-29, delete both lines in their entirety and insert in their place --In a particular embodiment, the first and second--.

Page 3, lines 4-5, delete both lines in their entirety and insert in their place --The punching machine can further comprise a clutch--;

lines 12-13, delete both lines in their entirety and insert in their place --The punching machine can further comprise--;

line 19, delete in its entirety and insert in its place --A method of--.

Page 4, lines 14-15, delete both lines in their entirety and insert in their place --The method can further comprise the step of:--;

lines 26-27, delete both lines in their entirety and insert in their place --The method can further comprise the step of:--;

lines 36-37, delete both lines in their entirety and insert in their place --The method can further comprise the step of:--.

Page 5, line 9, change "claim 9" to --another embodiment--.

Page 6, line 18, after "with" change "a" to --an--;

line 32, after "motor" insert --21--, and change "Y 21." to --Y.--;

line 34, after "motor" insert --21--, and after "Y" delete "21";

line 37, change "so that the lower frame 5 can be slided." to --to slide over the lower frame 5.--

Page 7, line 16, after "motor" insert --27--, and after "U" delete "27";

line 19, after "motor" insert --31--, and after "V" delete "31";

line 24, after “motor” (first occurrence) insert --27--, after “U” delete “27”, after “motor” (second occurrence) insert --31--, and after “V” delete “31”.

Page 8, line 3, after “screw” insert --43--, and after “X₁” delete “43”;

line 5, after “screw” insert --43--, and after “X₁” delete “43”

line 7, after “screw” insert --43--;

line 8, delete “43”;

line 10, after “motor” insert --49--, and after “X₁” delete “49”;

line 12, after “screw” insert --43--, change “X₁ 43.” to --X₁--, and after “member” insert --51--;

line 13, delete “51”, after “screw” insert --43--, and change “X₁ 43.” to --X₁--;

line 14, after “member” insert --51--, after “X₁” delete “51”, and after “carriage” insert --55--;

line 15, delete “55”;

line 18, after “motor” insert --49--, and after “X₁” delete “49”;

line 21, after “member” insert --51--, after “X₁” delete “51”, and after “carriage” insert --55--;

line 22, change “X₁ 55.” to --X₁--;

line 25, after “screw” insert --59--, and after “X₂” delete “59”;

line 27, after “screw” insert --59--, and after “X₂” delete “59”;

line 29, after “screw” insert --59--;

line 30, after "X₂" delete "59";

line 32, after "drive motor" insert --65--, and after "X₂" delete "65";

line 34, after "screw" insert --59--, change "X₂ 59." to --X₂--, and after "member"

insert --67--;

line 35, delete "67", after "screw" insert --59--, and change "X₂ 59." to --X₂--;

line 36, after "member" insert --67--, after "X₂" delete "67", and after "carriage"

insert --71--;

line 37, after "X₂" delete "71".

Page 9, line 2, after "motor" insert --65--, and after "X₂" delete "65";

line 5, after "member" insert --67--, after "X₂" delete "67", and after "carriage"

insert --71--;

line 6, change "X₂ 71." to --X₂--;

line 13, at the end of the line, insert --Thereby, it is possible to adjust a position.--;

line 14, after "screw" insert --43--, and after "X₁" delete "43";

line 15, after "screw" insert --59--, and after "X₂" delete "59";

line 16, delete "Thereby,";

line 17, delete "it is possible to adjust a position.";

line 18, after "pin" insert --75--, and after "X" delete "75";

line 25, after "pin" insert --75--;

line 26, delete "75";

line 29, after "motor" insert --49--, and after "X₁" delete "49";

line 30, after "screw" insert --43--, and change "X₁ 43." to --X₁--;

line 32, after "member" insert --51--, after "X₁" (first occurrence) delete "51",

after "carriage" insert --55--, and after "X₁" (second occurrence) delete "55";

line 36, after "motor" insert --65--, and after "X₂" delete "65".

Page 10, line 6, after "motor" insert --65--, and after "X₂" delete "65";

line 7, after "screw" (first occurrence) insert --59--, after "X₂" delete "59", and
after "screw" (second occurrence) insert --43--;

line 8, delete "43";

line 10, after "motor" insert --49--, and after "X₁" delete "49".

Page 11, line 1, after "carriage" insert --55--, and after "X₁" delete "55";

line 2, change "slided" to --slid--;

line 4, after "carriage" insert --71--, and after "X₂" delete "71";

line 5, delete "slided";

line 9, after "carriage" insert --55--, and change "X₁ 55." to --X₁--;

line 11, after "carriage" insert --71--;

line 12, change "X₂ 71." to --X₂--.

Page 13, lines 36-37, delete "according to claim 1 of the invention,".

Page 14, line 10, change the entire line to --The first and--;

line 17, change the entire line to --If necessary,--;

line 21, change the entire line to --It is possible--;

line 25, change the entire line to --The work can be--.

Page 15, line 4, change the entire line to --The work head--;

line 5, change "is" (first occurrence) to --can be--;

line 12, change the entire line to read --When the work--;

line 14, change "is" to --can be--;

line 18, change the entire line to --When a longer--;

line 20, change "is" to --can be--;

line 24, change the entire line to --The work head--;

line 25, change "is" to --can be--.

IN THE CLAIMS:

Please cancel claims 1-9 without prejudice to the subject matter therein and add new claims 36-57 as follows:

--36. A punching machine, comprising:

a body frame having a table, the table supporting a workpiece to be worked;

a first positioning device mounted on the table, the first positioning device positioning the workpiece in a first direction; and

a second positioning device mounted on the table, the second positioning device positioning the workpiece in the first direction; and

a working head mounted in the body frame so as to position in a second direction perpendicular to the first direction to punch the workpiece,

wherein the first positioning device and the second positioning device are arranged in series in the first direction;

wherein the first positioning device includes a first clamp to clamp a first margin of the workpiece in the first direction and a second clamp to clamp a second margin opposite to the first margin of the workpiece; and

wherein the first clamp can be moved to approach to the second clamp in the second direction.--

--37. The punching machine according to claim 36, wherein the first positioning device and the second positioning device are constructed in a manner such that the first positioning device and the second positioning device may alternately position the workpiece in the first direction.--

--38. The punching machine according to claim 37, wherein the workpiece is sheet shaped material uncoiled from a coiled material.--

--39. The punching machine according to claim 36, wherein
the first positioning device is located at one side of the working head on the table; and
the second positioning device is located at the other side of the working head on the
table.--

--40. The punching machine according to claim 36, further comprising a clutch
connecting the first positioning device to the second positioning device so that the first and the
second positioning devices transfer the workpiece in the first direction simultaneously.--

--41. The punching machine according to claim 36, wherein the first positioning device
has a plurality of clamps which clamp both margins parallel to the first direction of the
workpiece.--

--42. The punching machine according to claim 41, wherein the second positioning
device has a plurality of clamps which clamp both margins parallel to the first direction of the
workpiece.--

--43. A punching machine, comprising:
a body frame having a table supporting a workpiece to be worked;
a first positioning device mounted on the table positioning the workpiece in a first
direction;

a second positioning device mounted on the table positioning the workpiece in the first direction; and

a working head mounted in the body frame so as to position in a second direction perpendicular to the first direction to punch the workpiece,

wherein the working head comprises:

an upper tool holder holding a plurality of upper tools;

a lower tool holder holding a plurality of lower tools;

a ram actuating the upper tools and the lower tools to work the workpiece; and

a ram positioning mechanism shifting the ram in the first and second directions so as to be positioned at a location where the ram may actuate a predetermined upper tool and a lower tool cooperating with the predetermined upper tool to work the workpiece,

wherein the first positioning device includes a first clamp to clamp a first margin of the workpiece in the first direction and a second clamp to clamp a second margin opposite to the first margin of the workpiece; and

wherein the first clamp can be moved to approach to the second clamp in the second direction.--

--44. The punching machine according to claim 43, wherein

the first positioning device and the second positioning device are arranged in series in the first direction.--

--45. The punching machine according to claim 44, wherein the working head further comprises a C-shaped frame connecting the upper tool holder and the lower tool holder.--

--46. The punching machine according to claim 45, further comprising a plate holding clamp mounted on the body frame to hold down the workpiece against the table.--

--47. A method of punching, comprising the steps of:

clamping a first margin of a workpiece in a first direction by a first clamp of a first positioning device;

moving a second clamp toward the first clamp of the first positioning device;

clamping a second margin opposite to the first margin of the workpiece with the second clamp;

transferring the workpiece in the first direction with the first positioning device;

positioning a working head in a second direction perpendicular to the first direction;

punching the workpiece with the working head;

clamping the workpiece with a second positioning device;

unclamping the workpiece from the first positioning device; and

further transferring the workpiece in the first direction with the second positioning device,

wherein the first positioning device and the second positioning device clamp the same margin of the workpiece in a manner such that the first positioning device and the second positioning device are arranged in series in the first direction.--

--48. The method of punching according to claim 47, wherein the workpiece is sheet shaped material uncoiled from a coiled material.--

--49. The method of punching according to claim 48, further comprising transferring the workpiece in the first direction with the first and the second positioning devices simultaneously.--

--50. The method of punching according to claim 49, wherein the workpiece is clamped through a plurality of clamps mounted on the first positioning device which clamp both margins parallel to the first direction of the workpiece.--

--51. The method of punching according to claim 50, wherein the workpiece is clamped through a plurality of clamps mounted on the second positioning device which clamp both margins parallel to the first direction of the workpiece.--

--52. The method of punching according to claim 47, further comprising shifting a ram mounted in the working head in the first and second directions so as to select a predetermined upper tool and lower tool to cooperate with each other to work the workpiece.--

--53. The method of punching according to claim 52, further comprising:

transferring reversely the workpiece in a first direction by the first positioning device; and
forming the workpiece with the selected upper and lower tools.--

--54. A punching machine, comprising:

a body frame having a table, the table supporting a workpiece to be worked;

a first positioning device mounted on the table, the first positioning device positioning the workpiece in a first direction; and

a working head mounted in the body frame so as to be positioned in a second direction perpendicular to the first direction to punch the workpiece,

wherein the workpiece is sheet shaped material uncoiled from a coiled material;

wherein the first positioning device includes a first clamp to clamp a first margin of the workpiece in the first direction and a second clamp to clamp a second margin opposite to the first margin of the workpiece; and

wherein the first clamp can be moved to approach to the second clamp in the second direction.--

--55. The punching machine according to claim 54, further comprising a second positioning device mounted on the table, the second positioning device positioning the workpiece in the first direction.--

--56. The punching machine according to claim 55, wherein the first positioning device and the second positioning device are constructed in a manner such that the first positioning device and the second positioning device may alternately position the workpiece in the first direction.--

--57. The punching machine according to claim 55, further comprising a clutch connecting the first positioning device to the second positioning devices so that the first and the second positioning devices transfer the workpiece in the first direction simultaneously.--

IN THE ABSTRACT:

A substitute Abstract is attached hereto on a separate sheet.

IN THE DRAWINGS:

Approval is hereby requested for the drawing changes shown in red ink to Figs. 1, 4 and 5.

REMARKS

This Preliminary Amendment cancels claims 1-9 and adds new claims 36-57. Claims 36, 43, 47 and 54 are independent. As a result, claims 36-57 are now pending.

Should the Examiner believe that anything further is desirable in order to place the application into better condition for allowance, the Examiner is invited to contact the Applicants'

attorney at the telephone number listed below.

Please charge any shortage of fees or credit any overpayment thereof to BLANK ROME COMISKY & McCAULEY LLP, Deposit Account No. 23-2185 (0004.609/P). In the event that a petition for a separate petition for an extension of time does not accompany this Amendment, Applicants herewith petition under 37 C.F.R. §1.136(a) for an extension of time for as many months as are required to render this Amendment timely. Any fee due is authorized above.

Respectfully submitted,

Morikatsu MATSUDA et al

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ABSTRACT OF THE DISCLOSURE

A punching machine includes a body frame having a table to support a workpiece. First and second work movement positioning apparatuses are mounted at both sides to move and position the workpiece in a direction of axis X. A work head is mounted on the body frame and has a ram and a tool. The work head moves on the body frame in a direction of axis Y, which is perpendicular to axis X. The first and second work movement positioning apparatuses are arranged in series in the direction of axis X. The workpiece is clamped by the first positioning apparatus, moved in the direction of axis X, punched, clamped by the second positioning apparatus, unclamped by the first positioning apparatus, and moved further in the direction of axis X.

TITLE OF THE INVENTION

PUNCHING MACHINE AND METHOD THEREOF

TECHNICAL FIELD

The present invention relates to a punching machine and a method thereof which can move a work head comprising a ram and a tool in the direction of axis Y, and further can move a work clamp apparatus clamping a work in the direction of axis X.

BACKGROUND ART

Conventionally, as punching machines, a work head thereof comprising a ram and a tool is moved in the direction of axis Y, and a work clamp apparatus thereof clamping a work is moved in the direction of axis X, thereby, a work can be punched. This kind of punching machines are known in, for example, a Japanese Patent Publication No. 59-44938, a Japanese Patent Publication No. 59-45449 and so on.

According to this type of punching machine, in order to punch a thin and long work which is punched with few holes, it is necessary to punch the work at high speed. In such high-speed punching, there is a problem how to move the work clamp apparatus in the direction of axis X.

For example, it is very difficult to move at high speed a work of which dimension is 5,000 x 450 mm and thickness is 0.4 mm, in the directions of axis X and Y. Especially, it is difficult to move the work in the direction of the shorter dimension thereof.

In order to avoid for moving the work in the direction of the shorter dimension, the work head comprising the ram and the tool is moved in the direction of axis Y. However, when a work clamp apparatus is moved at high speed in the direction of axis X, the work head and the work clamp apparatus are interfered with each other, which are in a dangerous state. Further, a dead zone exists so that it is not possible to punch the work. Furthermore, there is a problem that it is not possible to use a tool of a plurality of tools in the work head, located farthest from the work clamp apparatus.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide a punching machine and a method thereof which can move a work clamp apparatus clamping a work in the direction of axis X without interfering with a work head, so that a dead zone does not exist and that the work is punched at high speed.

To achieve the object, according to claim 1 of the invention, a punching machine comprises a work head having a ram and a tool and moving in a direction of axis Y on a body frame, a first work movement positioning apparatus mounted at one side in the direction of axis X in a movable area of the work head in order to move and position the work in the direction of axis X, and a second work movement positioning apparatus mounted at the other side in the direction of axis X in order to move and position the work in the direction of axis X.

Accordingly, the work head comprising the ram and the tool which can move in the direction of axis Y is mounted on the body frame. The first and second work movement positioning apparatuses are mounted at both sides in the direction of axis X in the movable area of the work head, respectively. Thereby, it is possible to punch the work at high speed. Further, it is not necessary for the first and second work movement positioning apparatuses to enter into the movable area of the work head. Accordingly, it is possible to avoid interfering with the work head so that the dead zone does not exist.

According to claim 2 of the invention, as it depends from claim 1, in the punching machine, the first and second work positioning apparatuses comprise a carriage for axis X having a plurality of work clamps, a feed screw for moving a nut member integrated with the carriage for axis X, and a drive motor for rotating the feed screw, respectively.

Accordingly, the first and second work movement positioning apparatuses can be driven controlled individually. For example, while the work is positioned by the first or second work movement positioning apparatus, the

second or first work movement positioning apparatus can be moved to an arbitrary work holding stand-by position in order to position the work.

According to claim 3 of the invention, as it depends from claim 2, the punching machine further comprises a clutch mounted on the body frame so that the feed screws are engaged and disengaged by the clutch.

Accordingly, if necessary, each feed screw is engaged by the clutch means. Thereby, it is possible to rotate the feed screw by one drive motor in order to prolong a life span of the drive motor.

According to claim 4 of the invention, as it depends from claims 2 or 3, the punching machine further comprises a plate holding clamp mounted on the body frame for holding the work.

Accordingly, it is possible to move the work smoothly from the side of the first work movement positioning apparatus to the side of the second work movement positioning apparatus.

According to claim 5 of the invention, a method of punching, in a punching machine having a work head including a ram and a tool and moving in a direction of axis Y on a body frame, a first work movement positioning apparatus mounted at one side in a direction of axis X in a movable area of the work head in order to move and position the work in the direction of axis X, and a second work movement positioning apparatus mounted at the other side in the direction of axis X in order to move and position the work in the direction of axis X, the method comprises the steps of: positioning the work by the first work movement positioning apparatus in order to punch the work; and next, moving the work from the first work movement positioning apparatus to the second work movement positioning apparatus so that the work is positioned by the second work movement positioning apparatus in order to continue punching the work.

Accordingly, the work is positioned in the direction of axis X by the first work movement positioning apparatus. Further, the work head is moved in the direction of axis Y in the movable area in order to punch the work. Next, the

work is moved from the first work movement positioning apparatus to the second work movement positioning apparatus. The work is positioned by the second work movement positioning apparatus. The work head is moved in the direction of axis Y in the movable area in order to punch the work.

Accordingly, it is possible to punch the work at higher speed, compared to the conventional method. Further, the first and second work movement positioning apparatuses are not entered into the movable area where the work head is moved. Accordingly, the first and second work movement positioning apparatuses are not interfered with the work head. Further, there is not existed the dead zone where the work can not be punched.

According to claim 6 of the invention, as it depends from claim 5, the method further comprises the step of: holding the work by the first and second work movement positioning apparatuses in order to punch the work.

Accordingly, the work head is moved in the direction of axis Y. The work is held by the first and second work movement positioning apparatuses in order to punch the work. Accordingly, a tension is applied to the work in order to punch the work so that it is possible to enhance a workability precision. Further, since the work is slightly raised in order to be moved, it is possible to avoid scratching the lower surface of the work.

According to claim 7 of the invention, as it depends from claim 5, the method further comprises the step of: repeating positioning the work alternately by the first and second work movement positioning apparatuses in order to punch the work.

Accordingly, when the work head is moved in the direction of axis Y in order to punch the work, positioning the work is repeated alternately by the first and second work movement positioning apparatuses. Thereby, the work is moved in order to punch a longer work continuously.

According to claim 8 of the invention, as it depends from claims 5 or 7, the method further comprises the step of: positioning the second or first work movement positioning

apparatus to a work holding stand-by position while the work is held by the first or second work movement positioning apparatus in order to punch the work.

Accordingly, when a longer work is punched compared to a conventional method, the work is smoothly clamped and unclamped by the first and second work movement positioning apparatuses. Accordingly, it is possible to reduce a time for switching from clamping to unclamping of the work.

According to claim 9 of the invention, a method of punching, in a punching machine having a work head including a ram and a tool and moving in a direction of axis Y on a body frame, a first work movement positioning apparatus mounted at one side in a direction of axis X in a movable area of the work head in order to move and position the work in the direction of axis X, and a second work movement positioning apparatus mounted at the other side in the direction of axis X in order to move and position the work in the direction of axis X, the method comprises the steps of: positioning the work by the first and second work movement positioning apparatuses in order to bore the work when the work is moved forward in the direction of axis X; and next forming the work when the work is moved backward in the direction of axis X.

Accordingly, the work head is moved in the direction of axis Y in order to punch the work. First, the work is positioned by the first and second work movement positioning apparatuses when the work is moved forward in the direction of axis X in order to bore the work. Secondly, the work is formed when the work is moved backward in the direction of axis X. Thereby, since the formed rising portion is located in the direction far from the work head, it is possible to easily form the work partially upwardly as large as its height.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 shows a plan view of a punching machine according to an embodiment of the present invention.

Fig. 2 shows an enlarged cross-sectional view taken along the line II-II in Fig. 1.

Fig. 3 shows a schematic diagram explaining an operation of the present invention.

Fig. 4 shows a schematic diagram explaining an operation of the present invention.

Fig. 5 shows a plan view of a first and second work movement positioning apparatuses in Fig. 1 according to another embodiment of the present invention.

Figs. 6A, 6B and 6C show schematic diagrams explaining an example of a method of the present invention.

Figs. 7A, 7B, 7C and 7D show schematic diagrams explaining an example of a method of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Embodiments of the present invention are explained below in detail according to figures.

Referring to Fig. 1 and Fig. 2, a punching machine 1 comprises a gate-shaped body frame 3 which is standingly mounted. On the body frame 3, a lower frame 5 is integrated with an upper frame 7 by side frames. A C-shaped frame 8 is movably mounted between the lower frame 5 and the upper frame 7. A die block 9 and a punch block 11 mounting a plurality of dies D and punches P in rectangular arrangement, respectively, are faced with each other. The die block 9 and the punch block 11 are movably mounted at upper and lower portions on the C-shaped frame 8 in order to be moved in the direction of axis Y (upward and downward in Fig. 1).

A nut member 13 is integrated with the punch block 11. A ball screw 15 stretched in the direction of axis Y is thread-engaged with the nut member 13. The upper and lower portions (shown in Fig. 1) of the ball screw 15 are rotatably supported by bearings 17 and 19 in order to be rotated. The upper end (shown in Fig. 1) of the ball screw 15 is engaged with a drive motor for axis Y 21.

According to the above construction, when the drive motor for axis Y 21 is driven, the ball screw 15 is rotated. Thereby, the punch block 11 is moved in the direction of axis Y through the nut member 13. The die block 9 is mounted on the C-shaped frame 8 so that the lower frame 5 can be slid.

Accordingly, when the punch block 11 is moved in the direction of axis Y, the die block 9 can also be moved in the direction of axis Y through the C-shaped frame 8. Further, the die block 9 and the punch block 11 may be moved individually by different drive motors. In this case, preferably, the drive motors are synchronously driven.

As shown in Fig. 2, a ram drive unit 25 comprising a ram apparatus 23 is mounted on the upper frame 7. The ram apparatus 23 is positioned at the upper position over each punch P mounted on the punch block 11 in rectangular arrangement. The ram apparatus 23 is movable in the directions of axis U and V which are same as the directions of axis X and Y, respectively. Further, the ram apparatus 23 comprises a hydraulic cylinder in order to be moved upward and downward. The ram apparatus 23 is moved in the direction of axis U by a drive motor for axis U 27 and a transmission mechanism 29 in the ram drive unit 25. Further, the ram apparatus 23 is moved in the direction of axis V by a drive motor for axis V 31 and a ball screw 32. The tool of the punch P and the die D, and the ram apparatus 23 are generally called as a work head.

According to the above construction, the ram apparatus 23 is positioned in the directions of axis U and V by the drive motor for axis U 27 and the drive motor for axis V 31 in the ram drive unit 25. Thereby, the ram apparatus 23 is positioned in the upper position over where a desired punch P is positioned. The ram apparatus 23 is operated so that the desired punch P is punched. Thereby, the punch P and the die D are co-acted with each other in order to punch a work W.

A front table 33 and a rear table 35 are mounted at both sides of the body frame 3. The work W which is due to be punched is set on the front table 33. The work W is moved in the direction of axis X (in the right and left direction in Fig. 1) from the front table 33 to the rear table 35.

A first work movement positioning apparatus 37 and a second work movement positioning apparatus 39 are mounted on the front table 33 and rear table 35, respectively. A clump

base 41 of the first work movement positioning apparatus 37 is mounted at one side (at lower side in Fig. 1) of the front table 33. A ball screw for axis X_1 43 stretched in the direction of axis X_1 is mounted on the clump base 41. The right portion of the ball screw for axis X_1 43 is rotatably supported by a bearing 45 mounted on the clump base 41 in order to be rotated. The left portion of the ball screw for axis X_1 43 is rotatably supported by a bearing 47 mounted on the lower frame 5 in order to be rotated.

A drive motor for axis X_1 49 such as a servo-motor etc. having an absolute-encoder E1 is engaged with the right end of the ball screw for axis X_1 43. A nut member for axis X_1 51 is thread-engaged with the ball screw for axis X_1 43. The nut member for axis X_1 51 is integrated with a carriage for axis X_1 55 comprising work clamps 53A and 53B as a plurality of first work clamp apparatuses 53.

According to the above construction, when the drive motor for axis X_1 49 is driven, the ball screw 43 is rotated. Accordingly, the work clamps 53A and 53B of the first work clamp apparatus 53 are moved in the direction of axis X_1 through the nut member for axis X_1 51 and the carriage for axis X_1 55.

A clump base 57 of the second work movement positioning apparatus 39 is mounted at one side (at lower side in Fig. 1) of the rear table 35. A ball screw for axis X_2 59 stretched in the direction of axis X_2 is mounted on the clump base 57. The left portion of the ball screw for axis X_2 59 is rotatably supported by a bearing 61 mounted on the clump base 57 in order to be rotated. The right portion of the ball screw for axis X_2 59 is rotatably supported by a bearing 63 mounted on the lower frame 5 in order to be rotated.

A drive motor for axis X_2 65 such as a servo-motor etc. having an absolute-encoder E2 is engaged with the left end of the ball screw for axis X_2 59. A nut member for axis X_2 67 is thread-engaged with the ball screw for axis X_2 59. The nut member for axis X_2 67 is integrated with a carriage for axis X_2 71 comprising work clamps 69A and 69B as a plurality of second work clamp apparatuses 69.

According to the above construction, when the drive motor for axis X_2 65 is driven, the ball screw 59 is rotated. Accordingly, the work clamps 69A and 69B of the second work clamp apparatus 69 are moved in the direction of axis X_2 through the nut member for axis X_2 67 and the carriage for axis X_2 71.

The work clamps 53A and 53B of the first work clamp apparatus 53 and the work clamps 69A and 69B of the second work clamp apparatus 69 are constructed by a structure shown, for example, in Fig. 2 of a Japanese Patent Publication No. 2-37468. The structure comprises a position adjusting mechanism (clamp positioner) for clamping a work W and for adjusting a position of the clamp.

The left end of the ball screw for axis X_1 43 and the right end of the ball screw for axis X_2 59 can be engaged and disengaged by, for example, an electromagnetic clutch. Thereby, it is possible to adjust a position. 73 as clutch means mounted on the lower frame 5. A locate pin for axis X 75 is protrusibly retractably mounted near the side of the body frame 3 on the front table 33 by a cylinder etcetra.

An operation for punching the work W by the punching machine 1 is explained according to Fig. 3 and Fig. 4. Firstly, as shown in Fig. 2, the work W is transmitted onto the front table 33 at the L side (at the side of loading). The work W is positioned by a location of the locate pin for axis X 75 and of the work clamps 53A and 53B. Secondly, the work W is clumped by the work clamps 53A and 53B, then the punching starts.

That is, the drive motor for axis X_1 49 is driven in order to rotate the ball screw for axis X_1 43. Thereby, the work W clamped by the work clamps 53A and 53B through the nut member for axis X_1 51 and the carriage for axis X_1 55 is moved at the left side in Fig. 3. The punch P and the die D are co-acted with each other in order to punch the work W at a desired position. Since the electromagnetic clutch 73 is not engaged, the drive motor for axis X_2 65 is not driven.

The work W is punched so that the work W can be reached at the side of axis X_2 , that is, at the side of the rear table

35, as shown in Fig. 4. The work W is clamped by the work clamps 53A, 53B, and the work clamps 69A, 69B. That is, while the work clamps 53A, 53B, and 69A, 69B are being repositioned, the work W is transmitted.

In this state, the electromagnetic clutch 73 is engaged, the drive motor for axis X_2 65 is driven. Thereby, the ball screw for axis X_2 59 is rotated so that the ball screw for axis X_1 43 can also be rotated. Accordingly, the work W is subsequently being punched in order to be moved at the left side in Fig. 4. The drive motor for axis X_1 49 is turned off in order to be free. Further, the work W is punched in order to be positioned at the position shown by two chain dots line in Fig. 4. Since the work W is held by only the work clamps 69A and 69B, the electromagnetic clutch 73 is able to be disengaged. Since the work W can be punched on only axis X_2 , the work W can be transmitted without interfering with the work head. Further, it is possible to punch throughout the work W.

A next work W is loaded and is laid on an origin where the axis X_1 is positioned at an origin, so that the loading of the next work W is completed. The work W is in order to be positioned. That is, during punching the previous work W, the next work W is positioned in order to be loaded. Accordingly, it is possible to realize higher workability relative to the total working lot.

Fig. 5 shows an another embodiment alternative to the first and second work movement positioning apparatuses in Fig. 1. The elements having the same reference numbers in Fig. 5 are the same portions in Fig. 1. Accordingly, the detailed explanation of the same portions is omitted. The different portions are explained below.

Guide rails 79A and 79B stretched in axis X_1 in the first work movement positioning apparatus 37 are laid at the front and rear side (the upper and lower side) of the front table 33. Guide rails 81A and 81B stretched in axis X_2 in the second work movement positioning apparatus 39 are laid at the front and rear side (the upper and lower side) of the rear table 35. The lower portion at the front and rear side of a

gate-shaped carriage for axis X_1 55 is mounted on the guide rails 79A and 79B in order to be slid in the direction of axis X_1 . The lower portion at the front and rear side of a gate-shaped carriage for axis X_2 71 is mounted on the guide rails 81A and 81B in order to be slid in the direction of axis X_2 .

Work clamps 53A, 53B, 53C, 53D as the first work clamp apparatus 53 are mounted at the lower portion at front and rear side of the carriage for axis X_1 55. Work clamps 69A, 69B, 69C, 69D as the second work clamp apparatus 69 are mounted at the lower portion at front and rear side of the carriage for axis X_2 71.

According to the above construction, the work W is clamped by the work clamps 53A, 53B, 53C, 53D in order to be positioned in the direction of axis X_1 . Further, the work W is clamped by the work clamps 69A, 69B, 69C, 69D in order to be positioned in the direction of axis X_2 . The rest construction in Fig. 5 is same as the construction in Fig. 1. Accordingly, a detailed explanation is omitted. Accordingly, the work W is clamped front and rear, and right and left by the work clamps 53A, 53B, 53C, 53D and 69A, 69B, 69C, 69D or the work clamps 53B, 53D, 69B, 69D. Thereby, the tension can be applied to the work W so that it is possible to enhance workability precision. Further, it is possible to move the work W at high speed. Furthermore, since it is possible to slightly raise the work W in order to be moved, it is possible to avoid scratching the lower surface of the work W by the die D.

The work clamps 53A, 53B, 69A, 69B among the work clamps 53A to 53D and 69A to 69D are fixed. It is possible to move the work clamps 53C, 53D, 69C, 69D in the front and rear direction (upward and downward in Fig. 5) by a drive mechanism such as a drive motor 83 and a ball screw 85. Thereby, it is possible to correspond to the variation relative to a length of shorter side of the work W.

Next, another method of punching the work W by using the above punching machine 1 is explained below.

For example, as shown in Fig. 6A, the side of the right

end of a long work W is clamped by the work clamps 53A, 53B. The work W is moved at the left side in the direction of axis X_1 so that the punch block 11 and the die block 9 can be moved in the direction of axis Y. It is possible to operate a desired punching relative to the work W.

When the work clamps 53A, 53B is reached at a position shown in Fig. 6B, the side of the left end of the work W is clamped by the work clamps 69A, 69B. Further, the work W is unclamped by the work clamps 53A, 53B. The work W clamped by the work clamps 69A, 69B is moved at the left side on axis X_2 . The punch block 11 and the die block 9 can be moved in the direction of axis Y so that the work W is punched. It is possible to punch throughout the total work W. The work clamps 53A, 53B are returned to where they were. The work clamps 53A, 53B are returned to the work holding stand-by position, so that the work clamps 53A, 53B are in stand-by state in order to punch the next work W.

Accordingly, the work clamps 53A, 53B, 69A, 69B are not entered into the movable area where the punch block 11 and the die block 9 can move in the direction of axis Y. Therefore, it is possible to prevent the work clamps from interfering with the work W. Further, it is possible to punch the portion clamped by the work clamps 53A, 53B, 69A, 69B. Accordingly, the dead zone does not exist so that it is possible to punch the work W at high speed.

As shown in Fig. 7A, when the work W is very long, the work W is clamped by the work clamps 53A, 53B. The work W is moved at the left side on axis X_1 in order to punch the work W. Next, as shown in Fig. 7B, the work W is clamped by the work clamps 69A, 69B. The work W is unclamped by the work clamps 53A, 53B. As shown in Fig. 7C, the work clamps 69A, 69B is moved at the left side in the direction of axis X_2 in order to be punched. While the work W is punched, the work clamps 53A, 53B are returned to where they were. Thereby, the work W is clamped.

The work clamps 69A, 69B are unclamped at the position shown in Fig. 7C. As shown in Fig. 7D, the work clamps 53A, 53B are moved at the left side in the direction of axis X_1

in order to punch the work W. When the work clamps 53A, 53B are reached at the position as shown in Fig. 7D, the work clamps 53A, 53B are unclamped. The work W is clamped by the work clamps 69A, 69B. The work W is moved at the left side in the direction of axis X_2 in order to punch the work W.

Thus, the work W is clamped alternately by the work clamps 53A, 53B and 69A, 69B. The work W is moved at the left side in the direction of axis X_2 and X_1 in order to punch the work W. Thereby, it is possible to punch the very long work W, for example, even a coil member, continuously at high speed.

In the process shown in Figs. 6A, 6B and 6C, for example, the work W is bored. After then, in Fig. 6C, the work clamps 69A, 69B are moved at the right side in the direction of axis X_2 . The punch block 11 and the die block 9 are moved in the direction of axis Y in order to form the work W. In Fig. 6B, the work clamps 69A, 69B are unclamped. The work clamps 53A, 53B are clamped so that the work W is moved at the right side in the direction of axis X_1 , as shown in Fig. 6A. Thereby, it is possible to form the work W.

Thus, the work clamps 53A, 53B are moved at the left side in the direction of axis X_1 in order to bore the work W. The work clamps 69A, 69B are moved at the left side in the direction of axis X_2 in order to bore the work W. Further, the work clamps 69A, 69B are moved forward at the right side in the direction of axis X_2 in order to form the work W. The work clamps 53A, 53B are moved forward at the right side in the direction of axis X_1 in order to form the work W. Thereby, since the formed rising portion is located in the direction far from the punch block 11, it is possible to punch the work W easily as large as its height.

The present invention is not restricted to the above embodiments. The appropriate variation and deformation may be applied to other embodiments.

INDUSTRIAL APPLICABILITY

As understood by the above embodiments, according to claim 1 of the invention, the punching machine comprises the

work head having the ram and the tool and moving in a direction of axis Y on a body frame, the first and second work movement positioning apparatuses mounted at both sides in a direction of axis X in a movable area of the work head. Thereby, it is possible to punch the work at high speed. Since the first and second work movement positioning apparatuses are not entered into the movable area of the work head, it is possible to prevent from interfering with the work head. Further, the dead zone does not exist.

According to claim 2 of the invention, the first and second work movement positioning apparatuses can be driving controlled individually. For example, while the work is positioned by the first or second work movement positioning apparatus, the second or first work movement positioning apparatus can be moved to an arbitrary work holding stand-by position in order to position the work.

According to claim 3 of the invention, if necessary, each feed screw is engaged by a clutch. Thereby, it is possible to rotate the feed screw by one drive motor in order to prolong a life span of the drive motor.

According to claim 4 of the invention, it is possible to move the work smoothly from the side of the first work movement positioning apparatus to the side of the second work movement positioning apparatus.

According to claim 5 of the invention, the work is positioned in the direction of axis X by the first work movement positioning apparatus. Further, the work head is moved in the direction of axis Y in the movable area in order to punch the work. Next, the work is moved from the first work movement positioning apparatus to the second work movement positioning apparatus. The work is positioned by the second work movement positioning apparatus. The work head is moved in the direction of axis Y in the movable area in order to punch the work.

Accordingly, it is possible to punch the work at higher speed, compared to the conventional method. Further, the first and second work movement positioning apparatuses are not entered into the movable area where the work head is moved.

Accordingly, the first and second work movement positioning apparatuses is not interfered with the work head. Further, there is not the dead zone where the work can not be punched.

According to claim 6 of the invention, the work head is moved in the direction of axis Y. The work is held by the first and second work movement positioning apparatuses in order to punch the work. Accordingly, a tension is applied to the work in order to punch the work so that it is possible to enhance a workability precision. Further, since the work is slightly raised in order to be moved, it is possible to avoid scratching the lower surface of the work.

According to claim 7 of the invention, when the work head is moved in the direction of axis Y in order to punch the work, positioning the work is repeated alternately by the first and second work movement positioning apparatuses. Thereby, the work is moved in order to punch a longer work continuously.

According to claim 8 of the invention, when a longer work is punched compared to a conventional method, the work is smoothly clamped and unclamped by the first and second work movement positioning apparatuses. Accordingly, it is possible to reduce a time for switching from clamping to unclamping of the work.

According to claim 9 of the invention, the work head is moved in the direction of axis Y in order to punch the work. First, the work is positioned by the first and second work movement positioning apparatuses when the work is moved forward in the direction of axis X in order to bore the work. Next, the work is formed when the work is moved backward in the direction of axis X. Thereby, since the formed rising portion is located in the direction far from the work head, it is possible to easily form the work partially upwardly as large as height.

What is claimed is :

1. A punching machine comprising:

a work head having a ram and a tool and moving in a direction of axis Y on a body frame;

a first work movement positioning apparatus mounted at one side in a direction of axis X in a movable area of the work head in order to move and position the work in the direction of axis X; and

a second work movement positioning apparatus mounted at the other side in the direction of axis X in order to move and position the work in the direction of axis X.

2. The punching machine of claim 1, wherein the first and second work positioning apparatuses comprise a carriage for axis X having a plurality of work clamps, a feed screw for moving a nut member integrated with the carriage for axis X, and a drive motor for rotating the feed screw, respectively.

3. The punching machine of claim 2, further comprising: a clutch mounted on the body frame so that the feed screws are engaged and disengaged by the clutch.

4. The punching machine of claims 2 or 3, further comprising: a plate holding clamp mounted on the body frame for holding the work.

5. A method of punching, in a punching machine having a work head including a ram and a tool and moving in a direction of axis Y on a body frame, a first work movement positioning apparatus mounted at one side in a direction of axis X in a movable area of the work head in order to move and position the work in the direction of axis X, and a second work movement positioning apparatus mounted at the other side in the direction of axis X in order to move and position the work in the direction of axis X, the method comprising the steps of:

positioning the work by the first work movement positioning apparatus in order to punch the work; and next

moving the work from the first work movement positioning apparatus to the second work movement positioning apparatus so that the work is positioned by the second work

movement positioning apparatus in order to continue punching the work.

6. The method of claim 5, further comprising the step of: holding the work by the first and second work movement positioning apparatuses in order to punch the work.

7. The method of claim 5, further comprising the step of: repeating positioning the work alternately by the first and second work movement positioning apparatuses in order to punch the work.

8. The method of claims 5 or 7, further comprising the step of: positioning the second or first work movement positioning apparatus to a work holding stand-by position while the work is held by the first or second work movement positioning apparatus in order to punch the work.

9. A method of punching, in a punching machine having a work head including a ram and a tool and moving in a direction of axis Y on a body frame, a first work movement positioning apparatus mounted at one side in a direction of axis X in a movable area of the work head in order to move and position the work in the direction of axis X, and a second work movement positioning apparatus mounted at the other side in the direction of axis X in order to move and position the work in the direction of axis X, the method comprising the steps of:

positioning the work by the first or second work movement positioning apparatuses in order to bore the work when the work is moved forward in the direction of axis X; and next

forming the work when the work is moved backward in the direction of axis X.

ABSTRACT OF THE DISCLOSURE

The present invention provides a punching machine comprising: a work head having a ram and a tool and moving in a direction of axis Y on a body frame; a first work movement positioning apparatus mounted at one side in a direction of axis X in a movable area of the work head in order to move and position the work in the direction of axis X; and a second work movement positioning apparatus mounted at the other side in the direction of axis X in order to move and position the work in the direction of axis X, and further provides a method thereof.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Continuation Application of:)	
Appln. No. 08/836,029; filed)	
August 27, 1997 in the name of:)	Group Art Unit: Unassigned
)	
Morikatsu MATSUDA et al.)	Examiner: Unassigned
)	
Application No.: Unassigned)	Attorney Docket No. 000004.00609
)	
Filed: Concurrently Herewith)	
)	
For: PUNCHING MACHINE AND)	Date: September 13, 2000
METHOD THEREOF)	

Assistant Commissioner for Patents
Washington, D.C. 20231

REQUEST FOR APPROVAL OF DRAWING CHANGES

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Approval is hereby requested for the drawing changes shown in red ink to Figs. 1, 4 and 5
on the attached three sheets of drawings.

Respectfully submitted,

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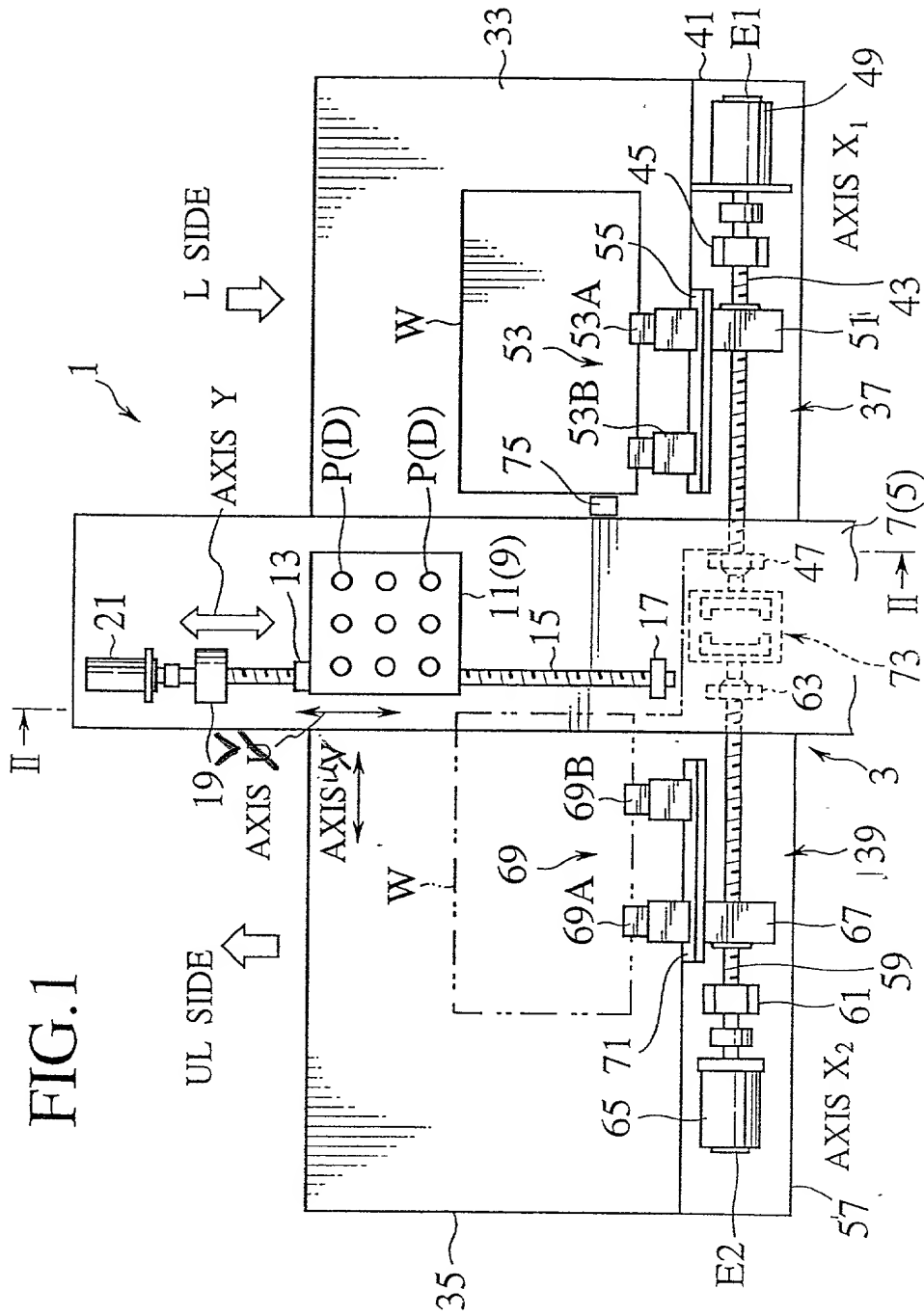


FIG. 4

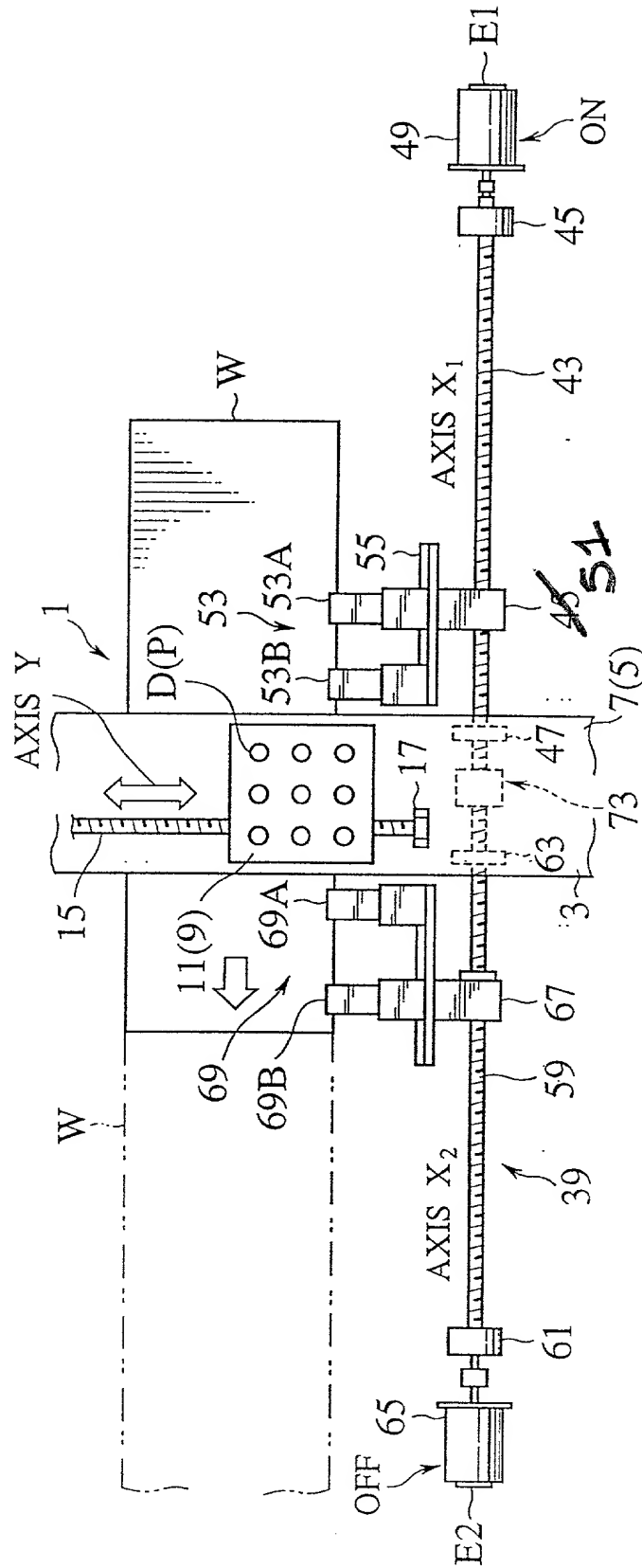
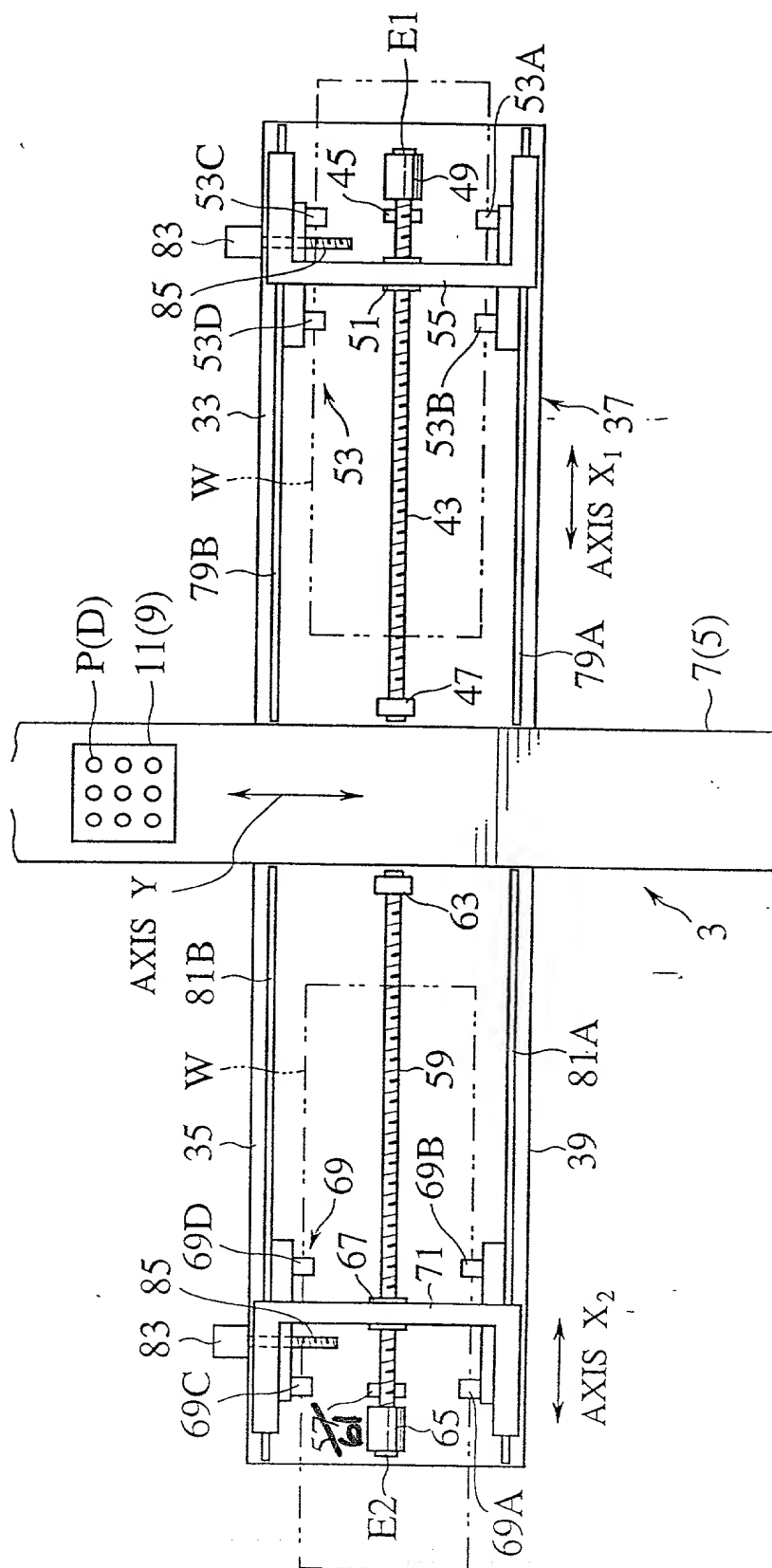


FIG. 5



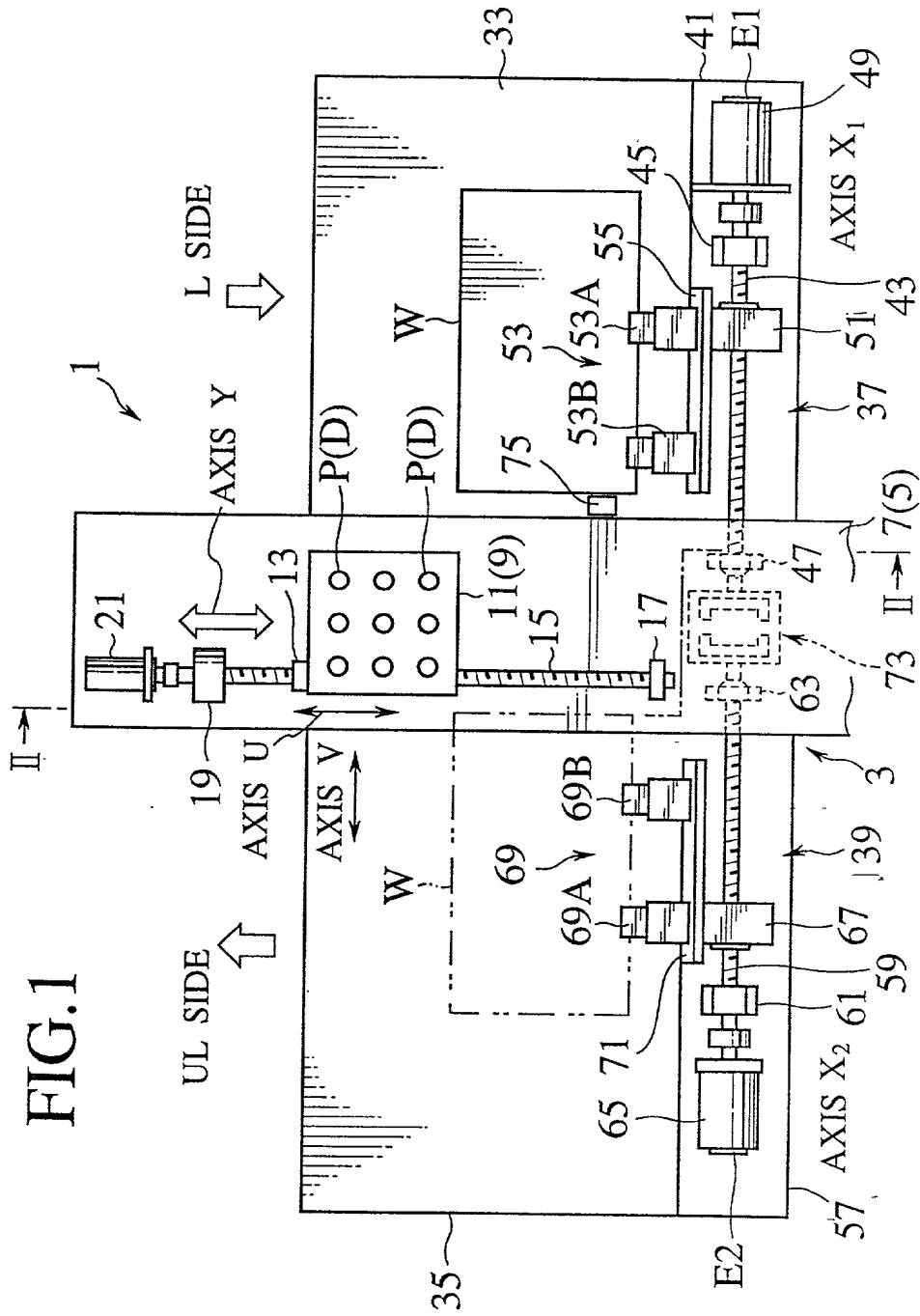


FIG.2

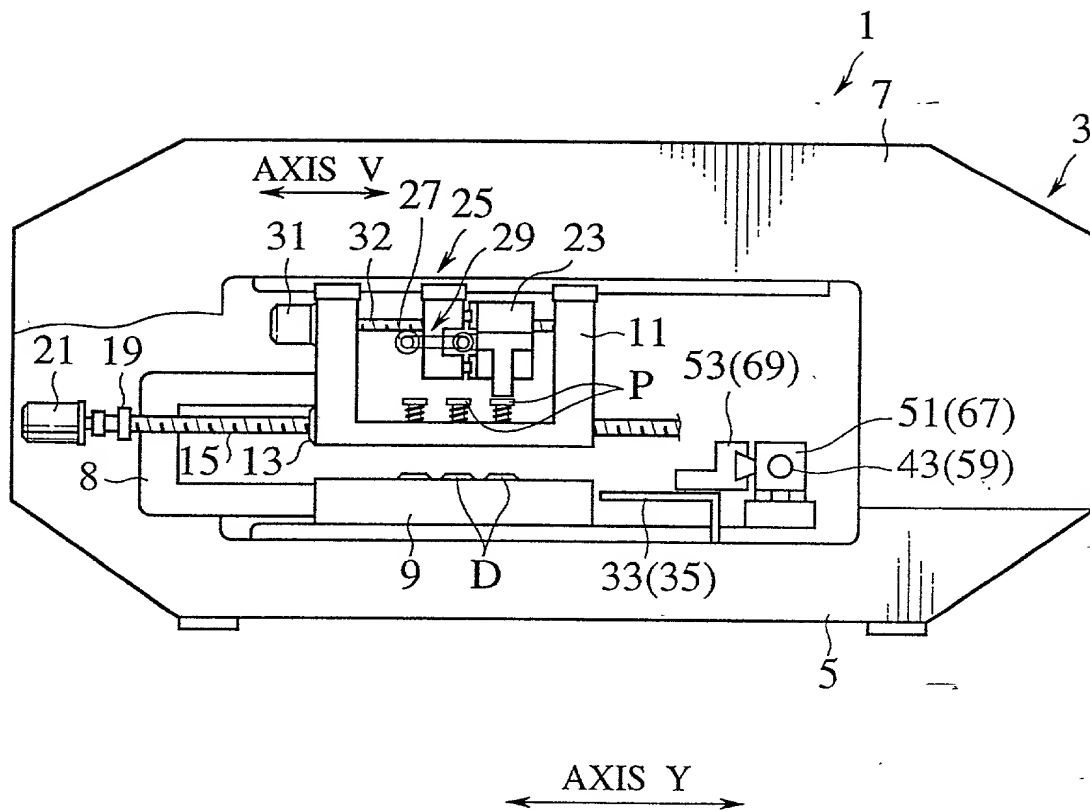


FIG. 3

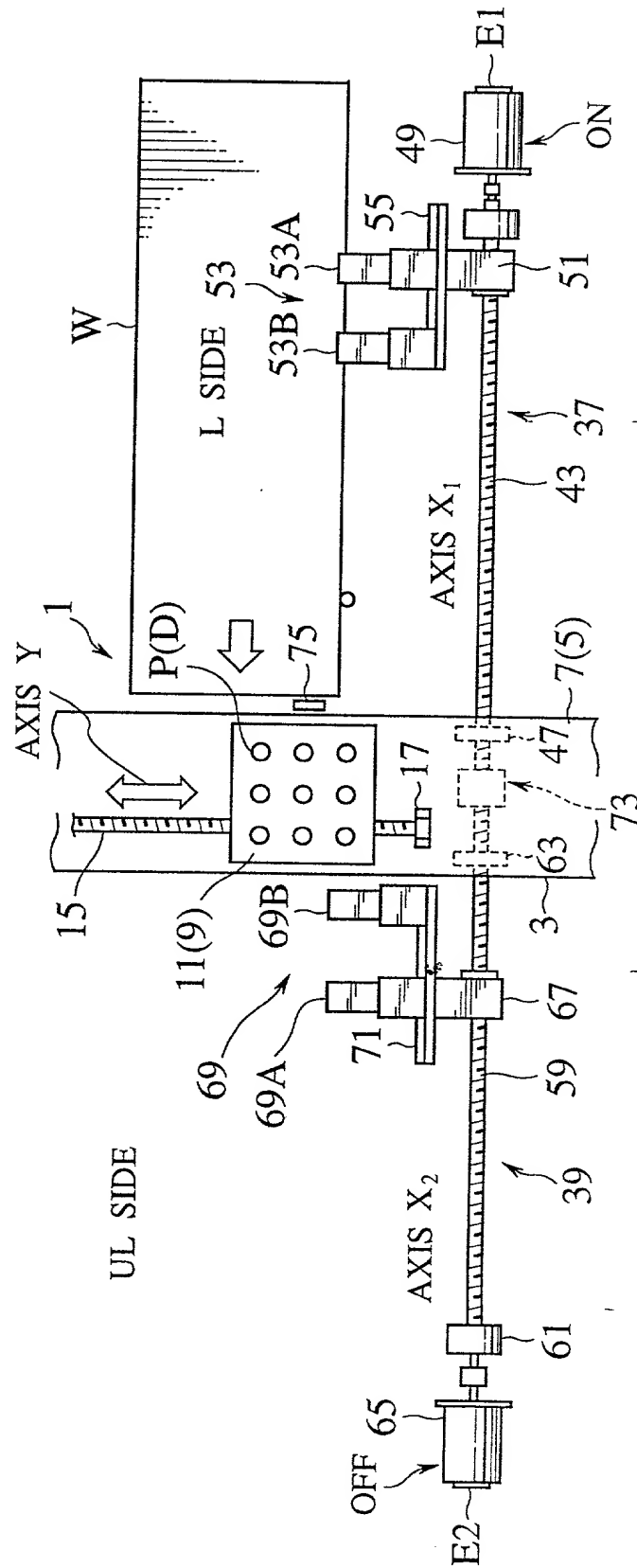


FIG.4

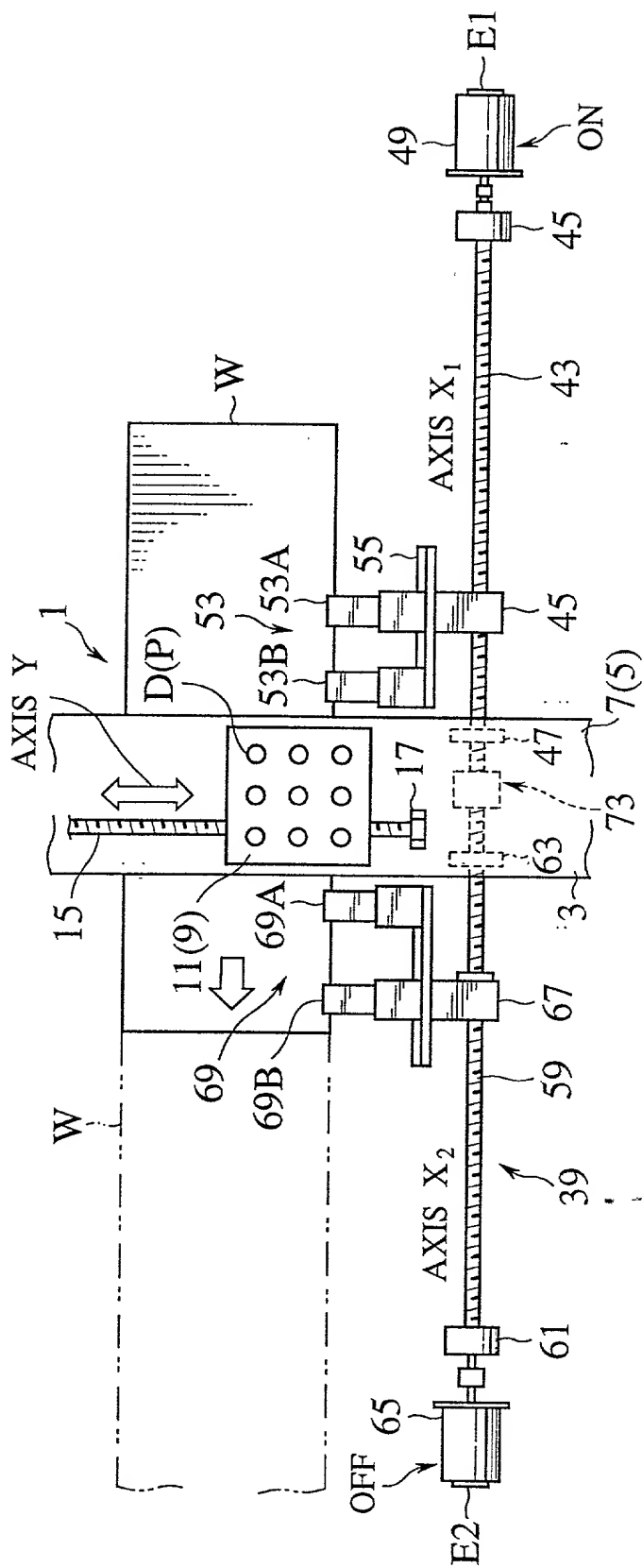


FIG. 5

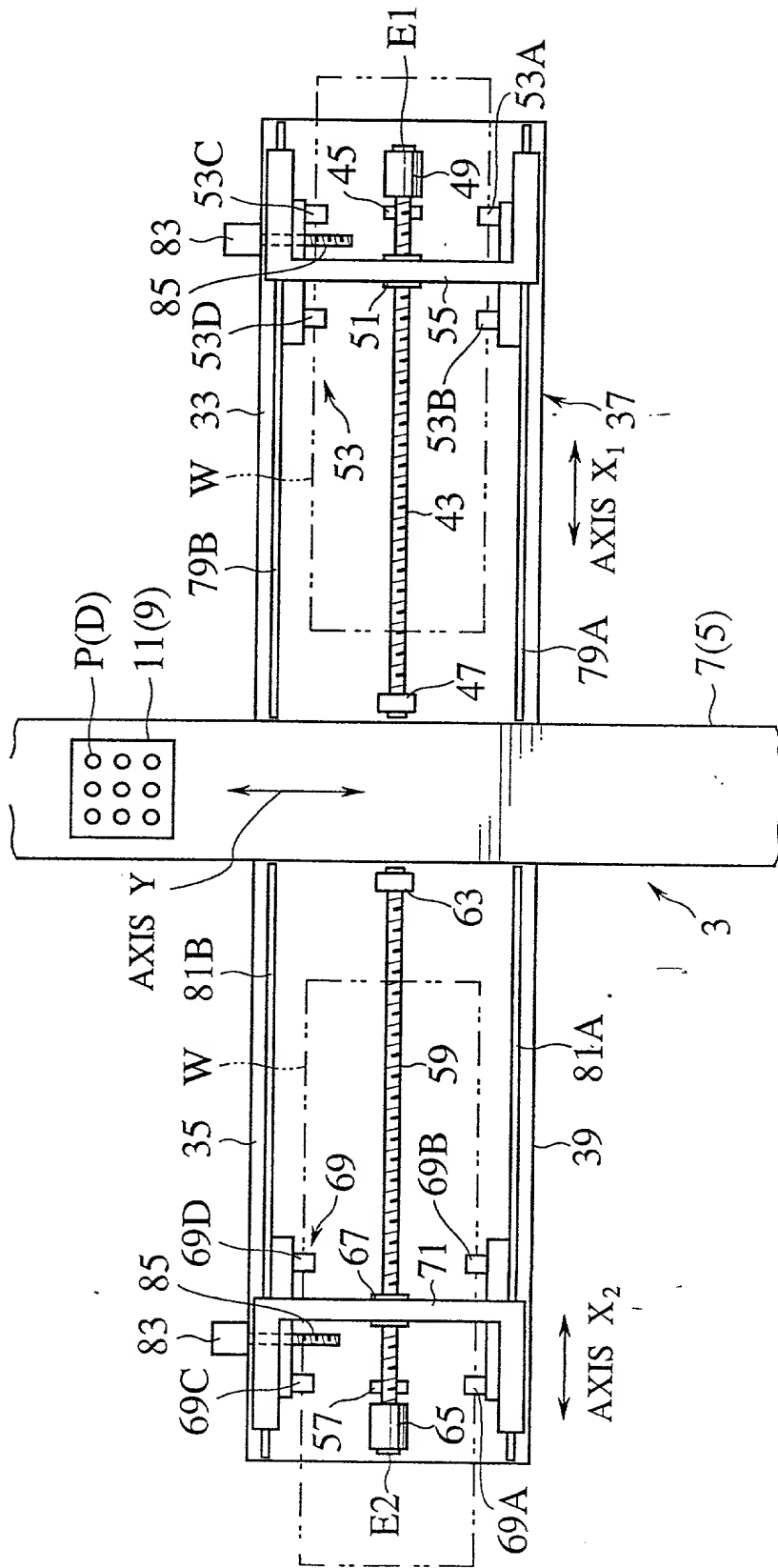


FIG. 6A

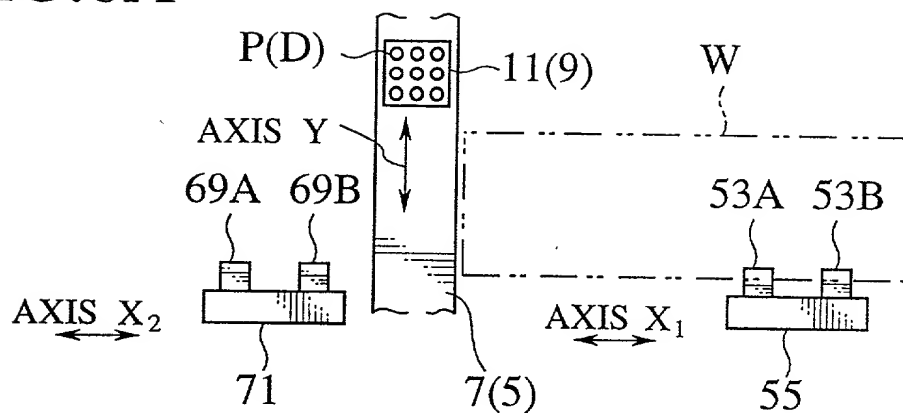


FIG. 6B

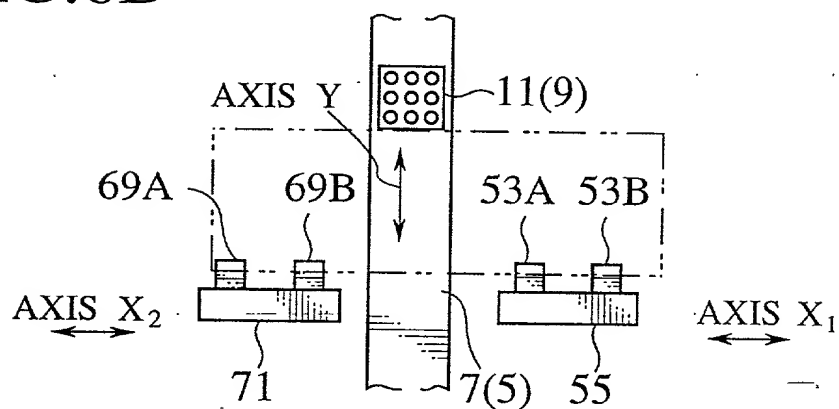
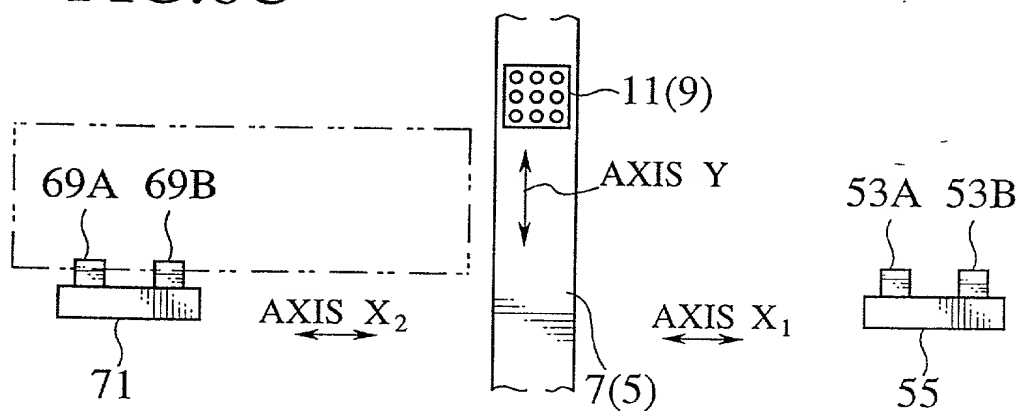
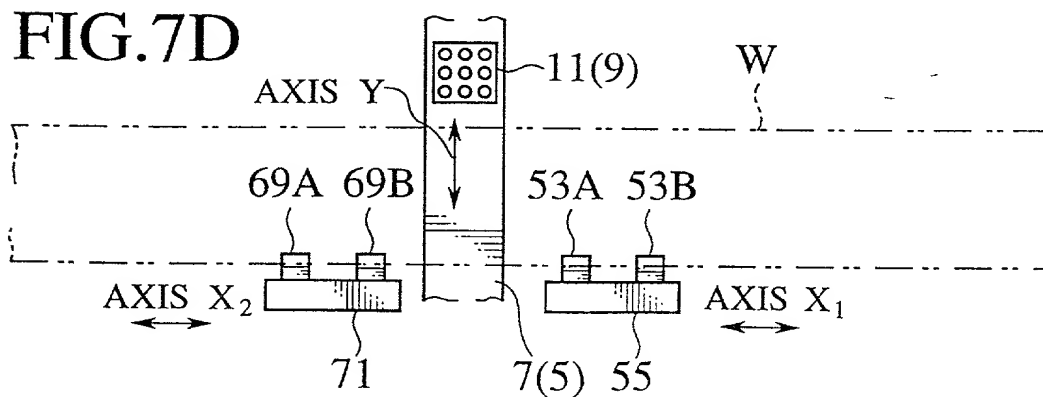
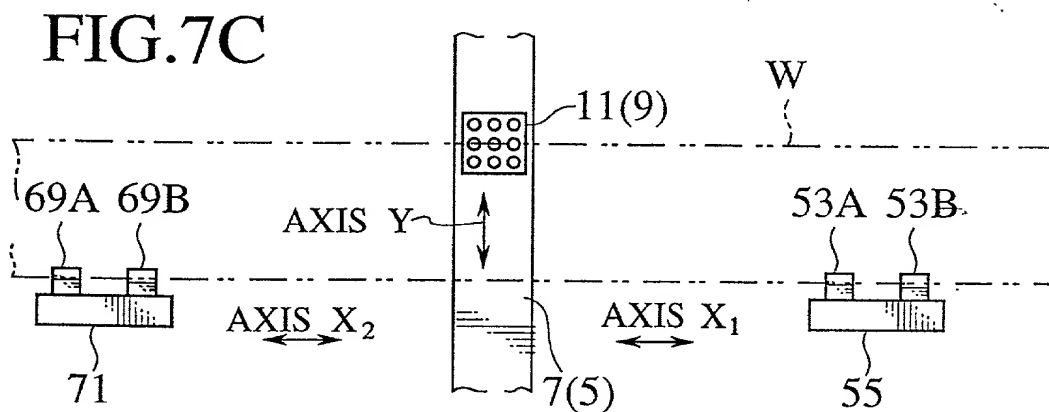
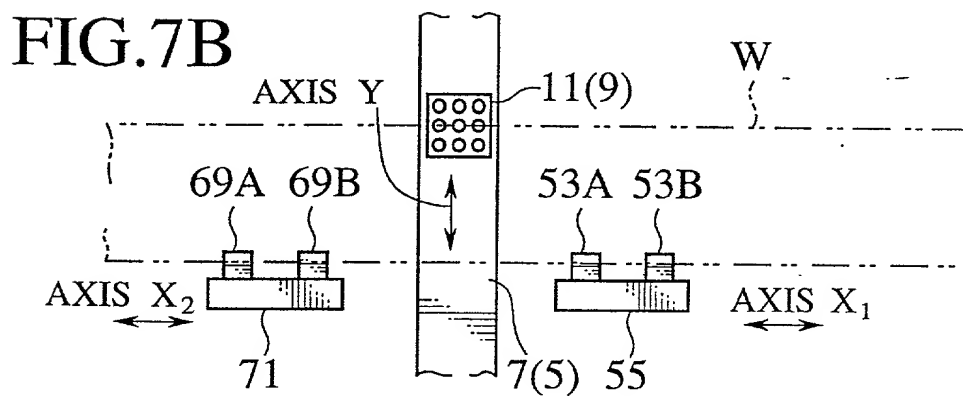
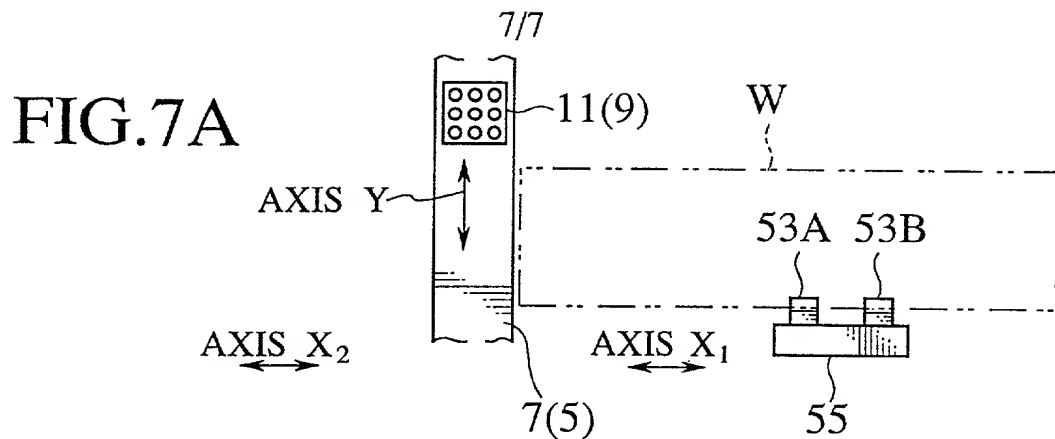


FIG. 6C





DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PUNCHING MACHINE AND METHOD THEREOF

the specification of which is attached hereto unless the following box is checked:

☒ was filed on April 25, 1997 as United States Application Number or PCT International Application Number 08/836,029 and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 USC §119			
APPLICATION NUMBER	COUNTRY	(DAY/MONTH/YEAR FILED)	PRIORITY NOT CLAIMED
JP7-301393	JAPAN	20/11/1995	<input type="checkbox"/> NO
			<input type="checkbox"/> NO

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

PROVISIONAL APPLICATION(S) UNDER 35 U.S.C. §119(e)	
APPLICATION NUMBER	FILING DATE

I hereby claim the benefit under 35 U.S.C. §120 of any United States application, or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. §112.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

PRIOR U.S./PCT INTERNATIONAL APPLICATION(S) DESIGNATED FOR BENEFIT UNDER 37 U.S.C. §120		
APPLICATION NUMBER	FILING DATE	STATUS -- PATENTED, PENDING, ABANDONED

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith: Herbert Cohen, Reg. No. 25,109; Victor M. Wigman, Reg. No. 25,201; George C. Myers, Jr., 27,040; Saul Leitner, Reg. No. 22,283; Michael C. Greenbaum, Reg. No. 28,419; Michael D. White, Reg. No. 32,795; Joseph G. Seeber, Reg. No. 27,719; and Karl O. Neidert, Reg. No. 39,313.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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